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QUANTITATIVE CHANGES IN TOTAL CARBOHYDRATE AND TOTAL NITROGEN CONTENTS OF SAWDUST OF *TECTONA GRANDIS, SHOREA ROBUSTA* AND *SWIETENIA MAHOGANI* DURING DECAY BY WHITE-ROT AND BROWN-ROT FUNGI

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Decomposition of total carbohydrate and total nitrogen in sawdust of three timber species, *Tectona grandia* L. f., *Shorea robusta* Gaertn., f. and *Swietenia mahogani* L. by white-rot fungi, *Polyporus arcularius* Batsch ex Fries, *Trametes cingulata* Berk and brown-rot fungi, *Polyporus ostreiformis* Berk., *Gloeophyllum striatum* (Swartz ex Fries) Murr. was investigated on the basis of quantitative estimation. White-rot fungi removed the total carbohydrate and total nitrogen more severely than the brown-rot ones and thus play very active role in the biodegradation of complex carbohydrate and nitrogenous substances in nature.

INTRODUCTION

In woody plant tissues, carbohydrates are present mainly in the form of cellulose and hemicellulose which form the structural material of cell walls. Small amount of starch and soluble sugars also occur as reserve food almost exclusively in the cytoplasm of parenchyma cells of the sapwood, Many of the wood-destroying basidiomycetes are known to be very efficient in utilizing carbohydrates and other carbon rich constituents of wood (Merrill and Cowling, 1965, 1966).

Although the supply of nitrogen in wood is meager, wood-destroying fungi presumably satisfy their nitrogen requirements primarily from the wood itself. In general, higher percentage of nitrogen exists in angiosperms than in gymnosperms, in sapwood than in heart wood and susceptibility of wood to decay is known to be directly related to such natural variation in nitrogen content (Merrill and Cowling, 1965, 1966). Since nitrogen constitutes a substantial fraction of the dry weight of active fungus tissue (Cochrane, 1958), wood-destroying fungi apparently must utilize large amount of wood substances to obtain sufficient nitrogen for production of abundant mycelia.

In India, general information about deterioration of wood by wood-decaying fungi is known, but quantitative data on the capacities of such organisms to degrade total carbohydrate and total nitrogen is still very limited. As such, present investigation has been undertaken to estimate the quantitative changes in total carbohydrate and total nitrogen contents of sawdust of three timber species, *Tectona grandis*, *Shorea robusta* and *Swietenia mahogani* subjected

to the attack of white-rot fungi, *viz. Polyporus arcularius* Batsch ex Fries, *Trametes cingulata* Berk, and brown-rot fungi, *viz. Polyporus ostreiformis* Berk., *Glosophyllum striatum* (Swarts ex Fries) Murr.

MATERIALS AND METHODS

Pure cultures from tissues of fresh fructifications of the test-fungi grown on malt agar media were used. Sawdusts of *Tectona grandis, Shorea robusta* and *Swietenia mahogani* collected from the sawmill were dried to constant weight, soaked in distilled water, sterilized and then subjected to decay by mycelia of *Polyporus arcularius, Trametes cingulara, Polyporus osteriformis* and *Gloeophyllum striatum* in conical flasks (500 ml) for a period of eight months at 28°C under controlled laboratory conditions. After removing the superficial mycelia the sawdusts were dried to constant weight, ground to pass into a 40-mesh screen and then used for quantitative estimation.

The total carbohydrates of the sawdusts were dissolved by hydrolysis in sulphuric acid (Saeman *et al,* 1954). The acid solution was used for quantitative estimation of total carbohydrate by colorimetric methods (Vogel, 1961). To 1 ml of above aliquot added 4 ml of 0.2% anthrone in conc H_2SO_4 (4 hrs. to 9 days old), mixed immediately by stirring with a glass rod and allowed to cool. After 10-15 minutes the tube is placed in a bath of cold water. The colour developed was stable from 5 minutes to 3 hours. The intensity of colour developed was measured colorimetrically in 615 mμ and the total carbohydrate content was expressed in mg/100 mg dry weight of the material.

Total nitrogen content of the sawdust was measured colorimetrically following mainly the method of Vogel by digesting 10 mg of dried sawdusts in 1 ml conc. H_2SO_4 in the presence of catalyst (20 g $CuSO_4$, $5H_2O$, 80 g K_2SO_4 and 0.34 g sodium selenate) for 1 hr. in a micro-Kjeldahl's flask. The homogeneous mixture was cooled to room temperature, bleached with 1 ml of H_2O_2 (30%) and the volume was made up to 10 ml with distilled water. 1 ml of this aliquot was finally treated with 5 ml of alkaline Nessler's reagent and 1 ml of mixture of 10% NaOH and Na_2SiO_3 (1 : 1). Intensity of the colour developed was measured by a Hilger pattern biochemical absorptiometer after 10 mins. at 430 mμ using a blank with identical treatments. Total nitrogen content was expressed as mg/100 mg dry weight and calculated from a standard curve of nitrogen prepared with potassium sulphate and ammonium sulphate.

RESULTS AND DISCUSSION

Total carbohydrate contents (Table 1) of sawdust of the three timber yielding plants are considerably high being maximum in *S. mahogani* followed by *S. robusta* and *T. grandis*. Some amount of loss in total carbohydrate content

after eight months becomes evident in the sawdust of all the timber species by all the test fungi. Of all the timber species sawdust of *S. mahogani* shows maximum loss of total carbohydrate by all the test-fungi which is followed in descending order by *S. robusta* and *T. grandis* respectively. The decomposition is comparatively less by brown–rot fungi than the white-rotted ones.

TABLE 1. *Quantitative changes in total carbohydrate contents of the sawdusts of* Tectona grandis, Shorea robusta and Swietenia mahogani *during decay by* T. cingulata Berk., P. arcularius Batsch Ex Fries, P. ostreiformis Berk. *and* Gloeophyllum striatum (Swartz ex Fries) Murr.

Timber Species	Total carbohydrate in sound sawdust (%)	Loss(%) of total carbohydrate due to decay by			
		T. cingulata	*P. arcularius*	*P. ostreiformis*	*G. striatum*
Tectona grandis	65.0	5.0	5.3	3.0	3.1
Shorea robusta	68.5	5.7	5.9	3 3	3.1
Sweitenia mahogani	71.0	6.0	6.3	4.1	3.9

TABLE 2. *Quantitative changes in total nitrogen cantents of sawdust of* Tectona grandis, Shorea robusta *and* Swietenia mahogani *during decay by* T. cingulata Berk., P. arcularius Batsch Ex Fries, P. ostreiformis Berk *and* G. striatum (Swartz Fries) Murr.

Timber Species	Total nitrogen in sound sawdust (%)	Loss (%) of total nitrogen of sawdust due to decay by			
		T. cingulata	*P. arcularius*	*P. ostreiformis*	*G. striatum*
Tectona grandis	0.250	64.5	60.0	55.0	51.3
Shorea rabusta	0.310	82.0	79.5	65.3	63.1
Swietenia mahogani	0.413	85.5	80.0	70.5	70.0

From Table 2, it is evident that total nitrogen contents of the sound sawdust of three timber species differ considerably being maximum in *S. mahogani* and minimum in *T. grandis*. Percentage of total nitrogen in decayed sawdust decreases increasingly during the process of decay. Of the three timber species, the percentage of loss in nitrogen content is maximum in *S. mahogani* where original nitrogen content is maximum while *T. grandis* having minimum nitrogen

content shows minimum loss. The white-rot fungi causes greater degradation of total nitrogen from all the timber species in comaprison to the brown-rot fungi under consideration.

Results of the laboratory experiments showed that sawdust of the three timber species was severely affected by the white-rot fungi in comparison to brown-rot ones. Thus white-rot fungi proved to be very important and play active role in the bioconversion of complex carbohydrates and nitrogenous substances in nature.

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